MEMORANDUM

TO: BDAC Ecosystem Restoration Workgroup

FROM: Bruce Herbold, USEPA

RE: Tools to get to quantification of environmental restoration goals

DATE: May 13, 1996

Identification and quantification of restoration targets is a necessary part of the CalFed planning process. This memo responds to discussion at the workgroup meeting on the habitat needs of estuarine fish and to identify some tools to set reasonable quantification of amounts that restoration efforts might target. It reflects only my personal thoughts and knowledge and is not an official USEPA guidance statement.

The minimum amount of restoration would seem to be that necessary to achieve the goals described in the Delta Native Fishes Recovery Plan and the Winter-run Chinook Salmon Recovery Plan. The doubling goal of the CVPIA and the narrative SWRCB salmon standard provide other restoration goals. These goals are generally set in terms of the abundance, distribution or other biological features of the targeted population. Sustainable sport and commercial fisheries at some historical level provides another easily identified set of goals. These kinds of goals are called 'diagnostic goals' below.

California's Fish and Game restoration plan for anadromous fishes (A Plan for Action), the working paper of the Anadromous Fish Restoration Plan, and the draft Anadromous Fishes Restoration Plan of the Central Valley Project Improvement Act list actions that may be necessary to achieve whatever population goals are chosen. These recommendations are called 'actions' below.

Because little large-scale restoration work has been attempted in this region it is not possible to quantify the relationship between restoration actions and achievement of the desired diagnostic goals. Thus, an important part of the first restoration efforts will be to use intentionally different levels of effort or different types of actions so that comparisons can guide future actions. This experimental approach has been successfully used elsewhere and has been termed 'adaptive management.' It is important to distinguish this from a trial-and-error methodology where results are examined post hoc and no effort is made to develop beforehand the experimental design and monitoring programs that adaptive management entails.

The following discussion focusses on quantifying the amount of 'actions' that may be needed to achieve the 'diagnostic goals.' These amounts are called 'prescriptive goals.' Actions where 'adaptive management' should be incorporated are noted. Discussion is limited to conditions within the delta.

Migratory pathways

An important role of the delta in ecosystem function is as a migratory corridor for anadromous species. Anadromous species include steelhead, green sturgeon, white sturgeon, lampreys, and four runs of chinook salmon. Because they are best studied and understood salmon are probably the best species upon which to base the protection of migratory functions

Salmon smolt survival through the delta is believed to be poor, particularly at times when levels of use and export are high relative to inflow. EPA's rule aimed at doubling the fall-run salmon survival rate through the delta, the working paper of the AFRP aimed at similar goals, and the state's Water Quality Control Plan for the Delta contains a narrative standard to double salmon production relative to the 1967-1991 historic averages. Thus, the diagnostic goal, at least for the short term, has been widely agreed upon. Although achieving the CVPIA and SWRCB goals will require more actions than doubling salmon survival rates through the delta, the AFRP working paper suggested that such a local goal is consistent with any overall plan of protection. Long-term diagnostic goals might refer to the SWRCB's stated desire for 'without project' conditions in the water rights permits given to the projects. These delta diagnostic goals will need to be consolidated with broader diagnostic goals such as doubling production or achieving sustainable historic harvest rates.

Habitat conditions along the lower rivercourses for outmigrating salmon smolts provide little of the kinds of cover and protection that characterize habitat use upstream. Salmon moving through the delta are believed to use resting habitat during the day at upstream locations and during rising tides at downstream locations. Therefore, cover and other protective habitat is likely to be most useful for migration if patches of it are separated by no more than the distance traveled by smolts over a normal tidal cycle. Further considerations may involve supplying cover at appropriate intervals along both, rather than either shoreline, and the minimum size of such 'rest stops.'

The number of river miles to be augmented with suitably spaced patches of shaded riverine aquatic habitat, emergent vegetation, or other suitable smolt cover comprises the prescriptive goal. From the viewpoint of protecting a migratory species, the total length of each river would be the appropriate goal but in some particular areas such work may be impossible or prohibitively expensive. In the area of Steamboat and Sutter sloughs habitat might be improved along one migratory path more than another and mechanisms (such as acoustic or turbulence barriers to guide outmigrants toward the more favorable path should be explored).

Improvement of migratory success could easily be designed to maximize effectiveness through adaptive management. For instance, patches could be provided along only one side of part of the rivercourse. Comparison of survival rates upstream and downstream of the protected reach and between the protected and unprotected sides would provide a wealth of information to guide later efforts.

Floodplain habitats

Seasonally inundated areas are characteristic features of most estuarine ecosystems. Such floodplains are typically heavily used by many species for spawning and early growth and the

fishes of California are no exception. Human activities in the watershed have been directed toward reducing the size of the floodplain throughout the Central Valley. However, wet years like 1995 still provide extensive floodplain opportunities and are directly linked to successful fish recruitment as splittail demonstrated last year both in the bypasses on the Sacramento side and throughout much of the lower San Joaquin. Restoration of stable fish populations should include efforts to provide some measure of floodplain inundation in most springtimes.

Delta smelt

Spawning habitat is not believed to limit delta smelt abundance but there is some evidence, particularly in drier years, that almost all spawning occurs in a relatively small area of dead-end channels in the northwestern delta. Spawning occurs elsewhere and may vary with flow conditions in the preceding spring or the preceding winter. Inland silversides, which are very patchy in their distribution and largely limited to areas of perennial fresh water, have the potential to be a significant predator on delta smelt eggs and larvae.

Development of appropriate spawning grounds near Suisun Bay and in other areas of the delta would buffer the population from sensitivity to varying conditions on their primary spawning ground and increase the likelihood of larvae escaping severe mortality rates due to co-occurrence with a patch of silversides.

Rearing habitat is believed to consist largely of shallow open waters of intermediate salinity, although in many years substantial portions of the population have occurred within the delta. There is little information on habitat uses by smelt within the delta so that attempts to construct rearing and adult habitat within the delta will need to proceed incrementally to determine what is effective. Therefore, there appears to be no way to get at a biologically based quantification for such within-delta targets.

Chinook salmon fry rearing

In other estuaries chinook salmon often spend a significant amount of time feeding and growing in the estuary before smoltification is complete and the young fish move to the ocean. In the Sacramento-San Joaquin Delta extensive fry use of the delta has been observed principally in wetter years. Habitat for fry in the delta has become less suitable as more pumping has occurred in winter and early spring; under the new water quality control plan it is likely that export rates will become even greater during the months between October and February. Currently, insufficient data exist to set any quantitative diagnostic goals. Measures such as weight/length ratios (condition factor) or lipid content indicate successful fry rearing. Fry protection in the delta in wetter years should aim at diagnostic goals of survival and condition factors similar to those of years when fry rear upstream.

In order to set prescriptive goals for fry use of the estuary in wetter years one could examine the areal extent of the north delta channels that previously were a temporary home to fry and attempt to replicate that areal extent through development of comparable areas of habitat in the Yolo and Sutter bypasses. Principally this will involve controlling flow rates into the bypass and

ensuring adequate drainage design as water levels drop.

Adaptive management should assess differences in survival and condition of fry in the bypass with that in interior delta channels and compare both with condition of outmigrants in drier years.

Splittail

Levee construction has reduced splittail use of the delta in two ways: suitable spawning areas with flooded vegetation and marsh habitats with accumulations of their benthic prey.

The percent of flooded areas in the Yolo Bypass is the best predictor of year class success. Control of wetted areas in the bypass and of drainage patterns could allow reasonable splittail spawning success in all years. Currently, the bypass floods only in high flow years, duration of inundation is not controlled to ensure survival of spawned eggs, and receding waters often leave large ponds where many fish die. Natural freshwater marsh areas where splittail (and other native fishes) formerly spawned would not have presented these difficulties. Areas and periods of inundation could be timed for biological value and scaled in accord with unimpaired flows.

TIDAL MARSH FUNCTIONS

Delta resident fishes

The bulk of the splittail population appears to spend most of its time in Suisun Marsh and Bay. The historical range of this species extended all the way up the Sacramento Valley and up through the San Joaquin River. Its near absence as a resident from valley habitats is probably attributable to the absence of sufficient patch sizes of the dead-end, low velocity sloughs and emergent vegetation that characterize Suisun Marsh. Thus, re-establishment of freshwater marsh in the delta of an areal extent and physical character similar to Suisun Marsh would be a reasonable diagnostic goal. For splittail and other species it is likely that minimum patch size is an important guiding principle.

Suisun Marsh in the late '70s and early '80s was home to a diverse and predictable assemblage of the native delta fishes that tolerated moderate salinity intrusion. Along with splittail, these included tule perch, prickly sculpin, and Sacramento sucker. At suitable upstream habitats, where salinity never intrudes, this assemblage is joined by blackfish, squawfish, hitch, and (sometimes) delta smelt. The habitat needs of this assemblage are not well known but they are most often found in more marshy areas. That is, in areas with both channels and shallows and with well-dispersed stands of emergent vegetation. Recent discussions have focussed on mean depth as the parameter to be emphasized in restoration activities but diversity of depths is probably more ecologically important. Many of these species are believed to go into flooded vegetation to feed during high tides and to retreat to shallow channels during low tide. Restoration discussions have pointed out the absence of much shallow or shaded riverine aquatic habitat in the delta but it is the complex morphology that should be the target of actions and

prescriptive goals.

In Suisun Marsh introduced species of fish occupied a broader array of habitat types than the native species but there was no evidence that the abundance of striped bass, carp, or gobies depressed the abundance of the native fishes in areas of suitable habitat for native fishes. In the delta the array of introduced species is even broader and data on distribution and abundance of native species is more limited. If Suisun Marsh is an accurate guide to fish community dynamics elsewhere in the estuary, the restoration of suitable habitats for native species is apt to benefit those species despite negative impacts of introduced species in the area.